ITRAC-3: 3th Training Course on Illicit Trafficking and Radiological Consequences with Nucleonica,Karlsruhe, 11th May 2011

Using Nuclide Mixtures in Nucleonica

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Mixtures in Nucleonica

Nuclide Mixtures:

- Why mixtures ?
  - Mixture vs. simple nuclide
    → in the real life: mainly mixtures
  - Mixture vs. Compound
    → Nuclear properties are independent from chemical bonds
- Often used module in other applications

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Mixtures in Nucleonica

1. Nuclide mixtures overview e.g. U232+Co60
2. Case study with natural uranium
3. Exercise

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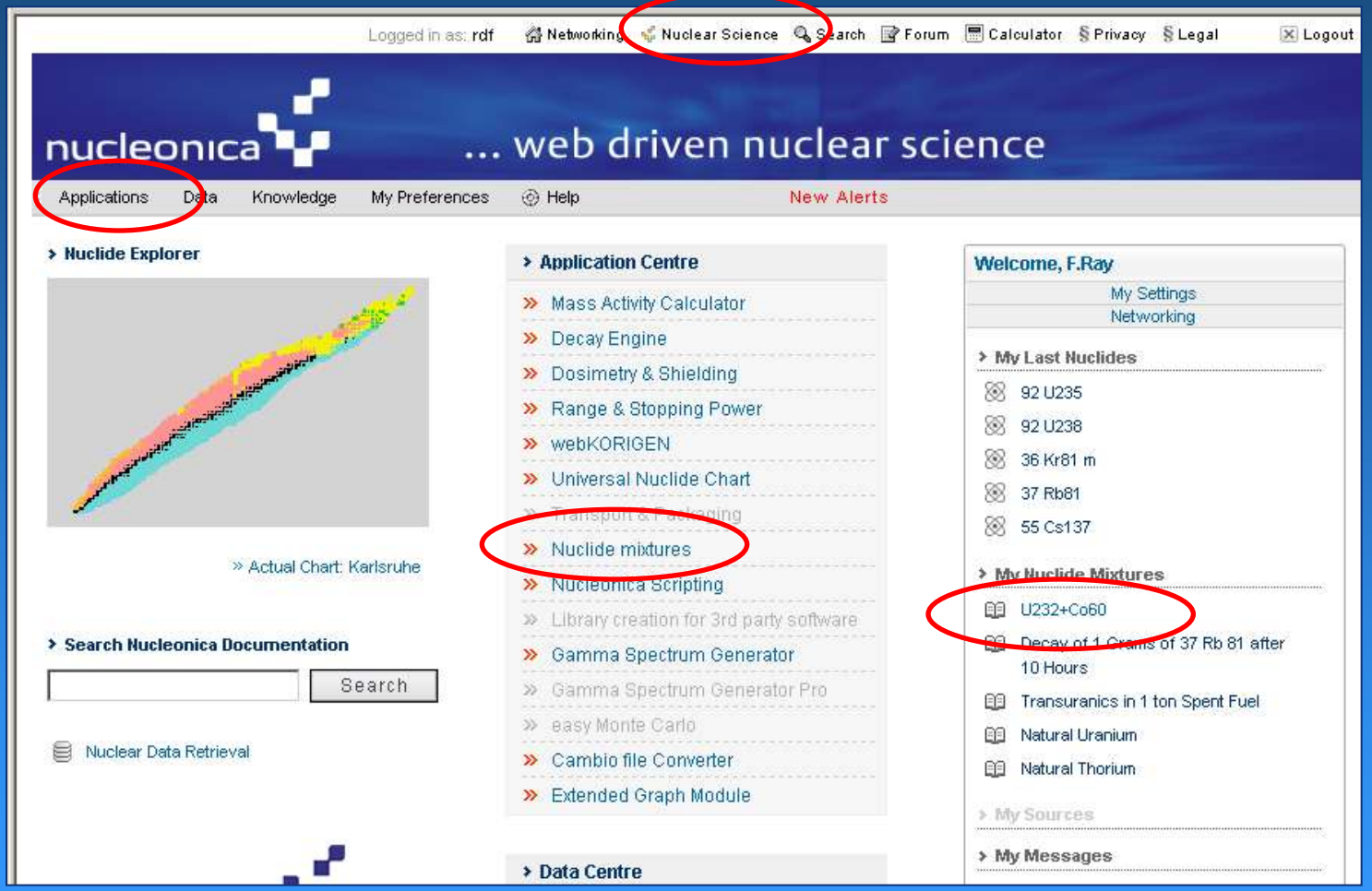
Go to Nuclide Mixtures



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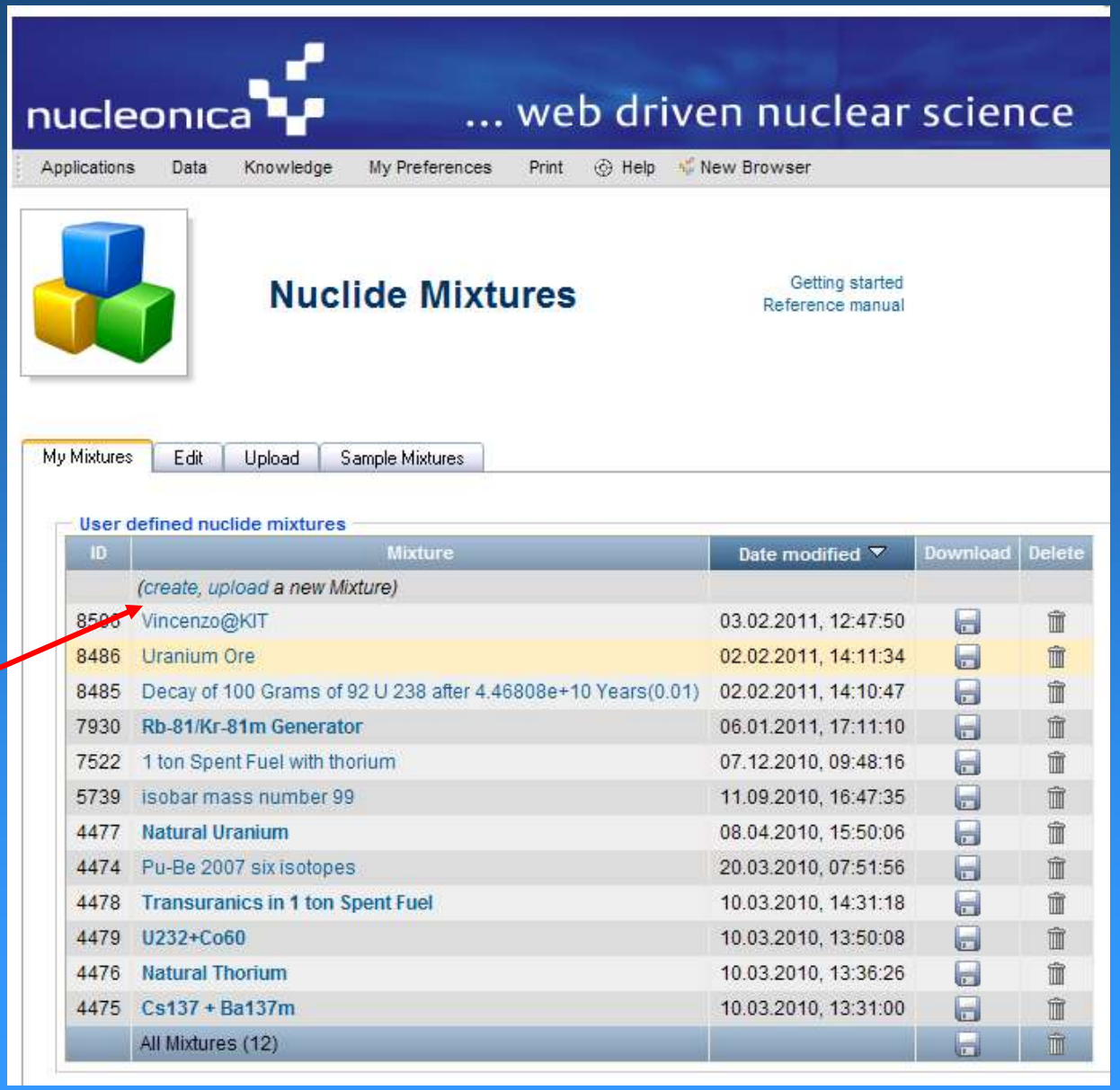
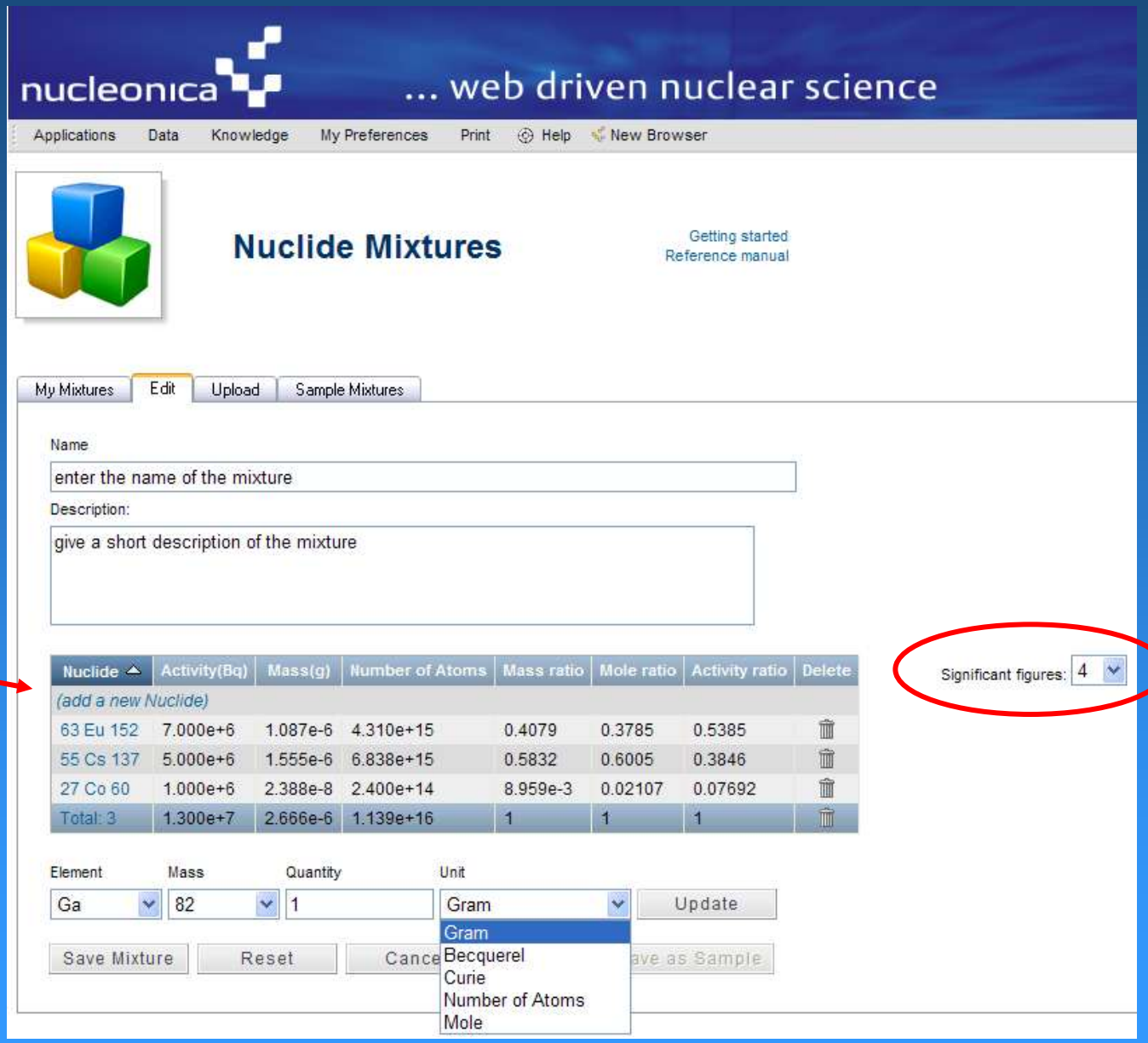
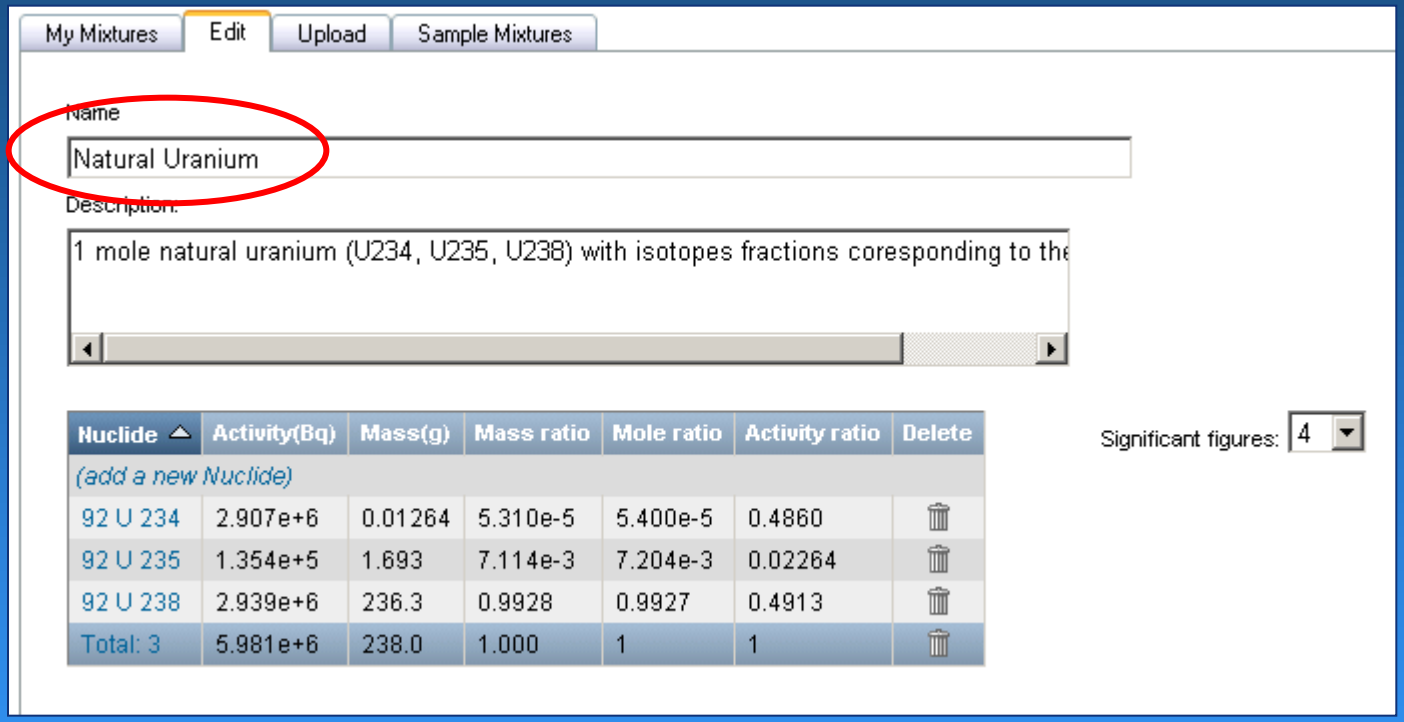
Nuclide mixtures: User Interface…



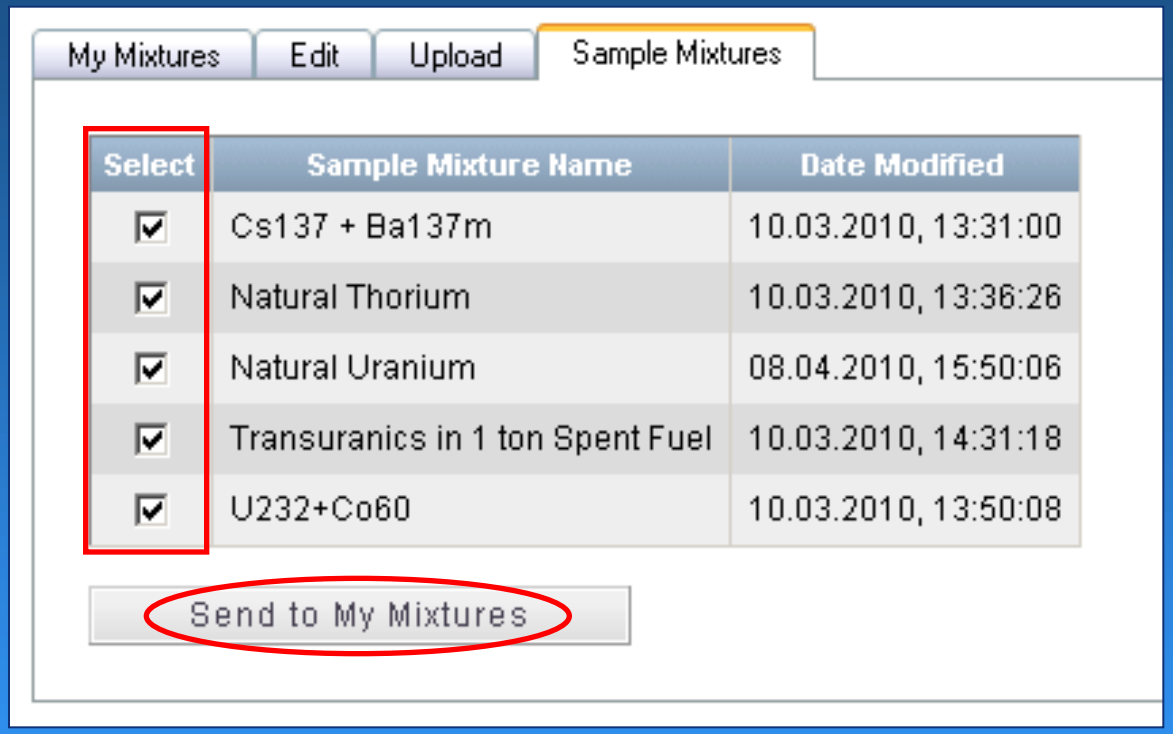
Create a new nuclide mixture….



Nuclide Mixtures
Example: natural uranium



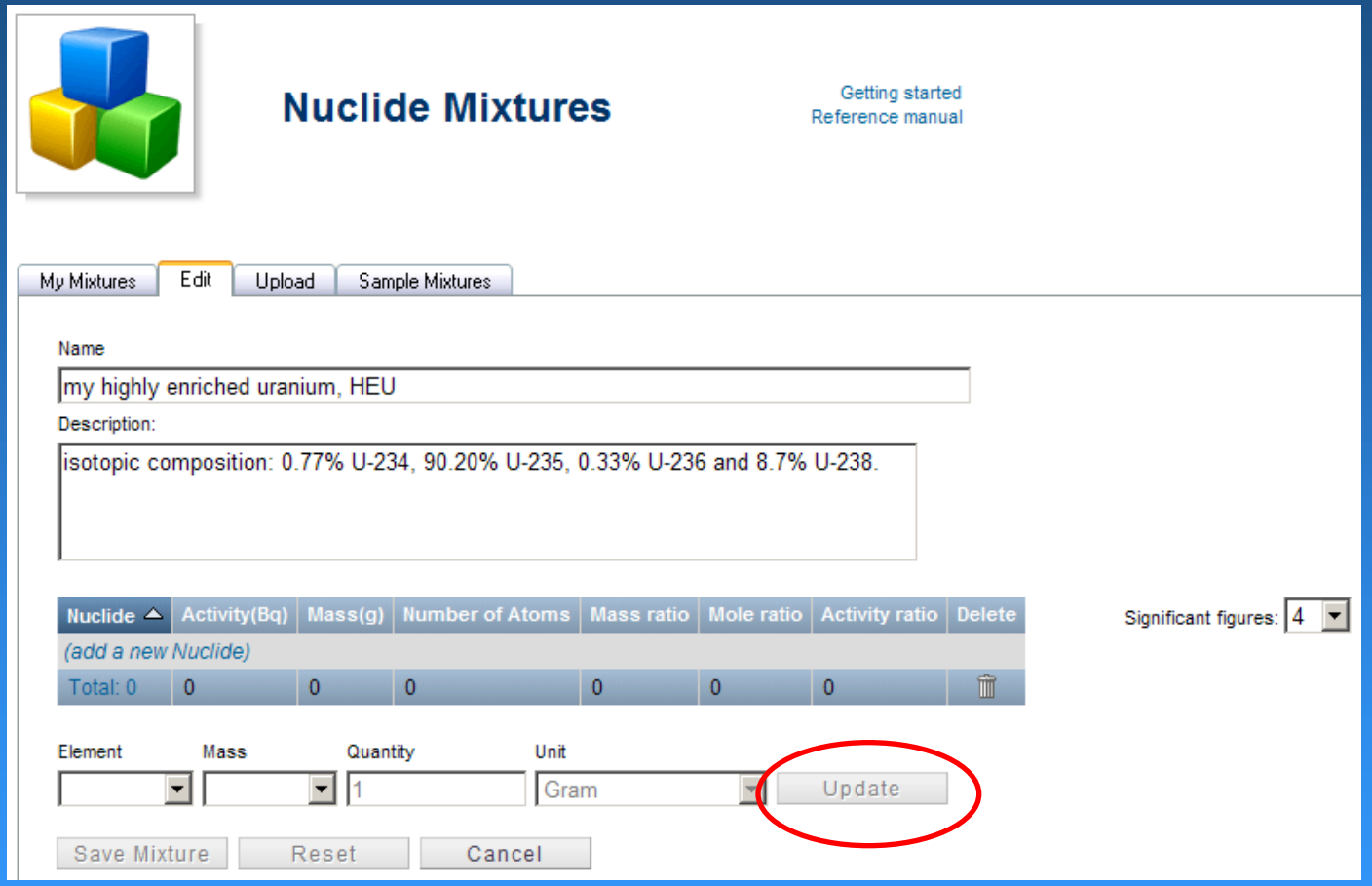
Nuclide Mixtures:
Pre-defined Mixtures



Create a new mixture:

Details

1. In Edit, enter a **name** for the mixture
2. Enter short description
3. Enter components → „(*add a new nuclide)*“
   - Choose a nuclide
   - Select a unit
   - Enter the quantity
   - Update grid
4. Save the mixture



Create a new mixture:

Details

My Mixtures | Edit | Upload | Sample Mixtures

Name

my highly enriched uranium, HEU

Description:

isotopic composition: 0.77% U-234, 90.20% U-235, 0.33% U-236 and 8.7% U-238.

Nuclide	Activity(Bq)	Mass(g)	Number of Atoms	Mass ratio	Mole ratio	Activity ratio	Delete
(add a new Nuclide)							
92 U 238	4.277e-17	3.439e-21	8.700	0.08802	0.087	5.940e-4	
92 U 236	3.058e-16	1.293e-22	0.33	3.310e-3	3.300e-3	4.248e-3	
92 U 235	2.815e-15	3.521e-20	90.20	0.9010	0.902	0.03910	
92 U 234	6.883e-14	2.992e-22	0.7700	7.659e-3	7.700e-3	0.9561	
Total: 4	7.200e-14	3.907e-20	100.0	1	1	1	

Significant figures: 4

Element | Mass | Quantity | Unit

1 | Gram | Update

Save Mixture | Reset | Cancel

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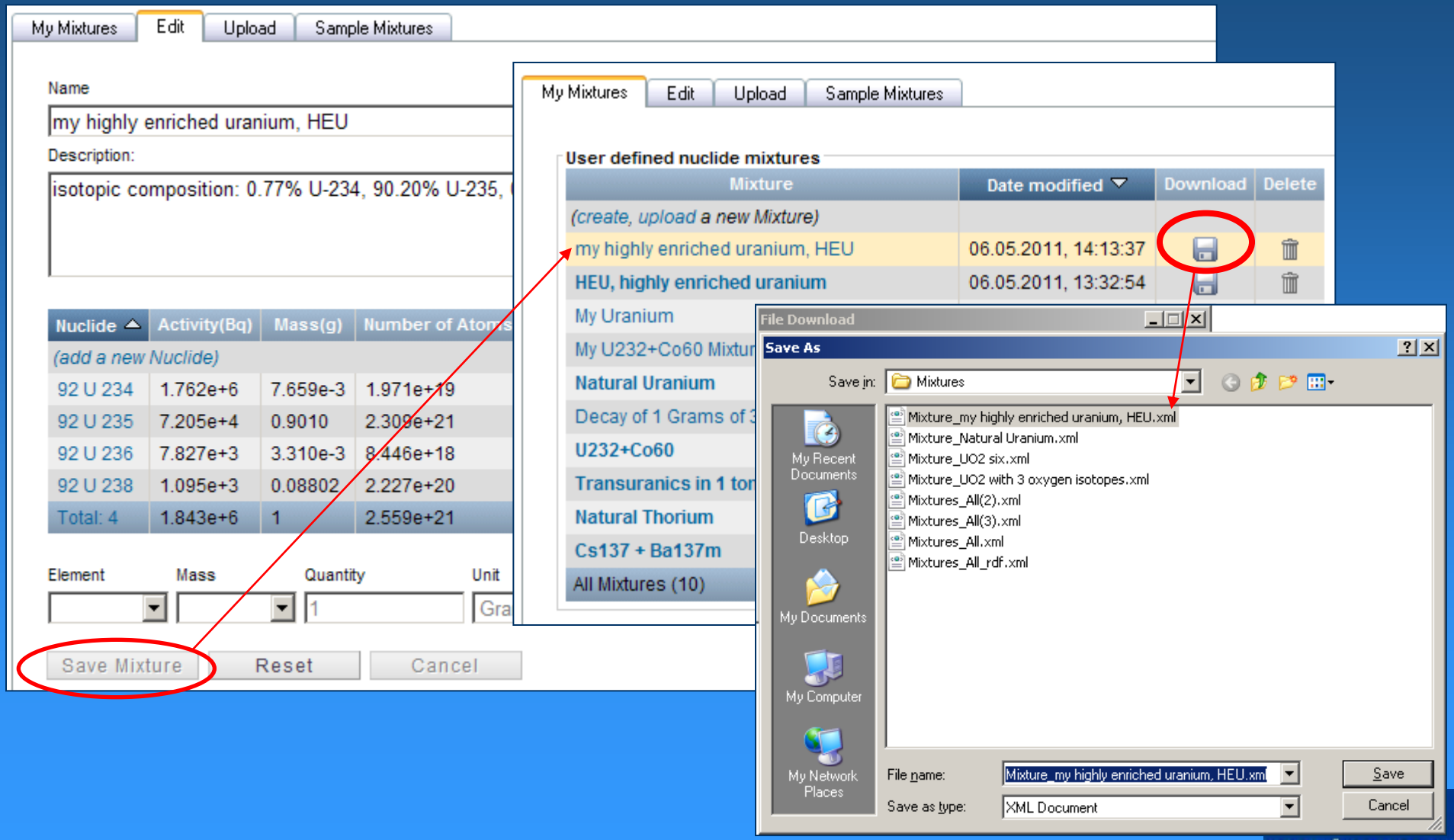
Create a new mixture:

Save & Download mixture



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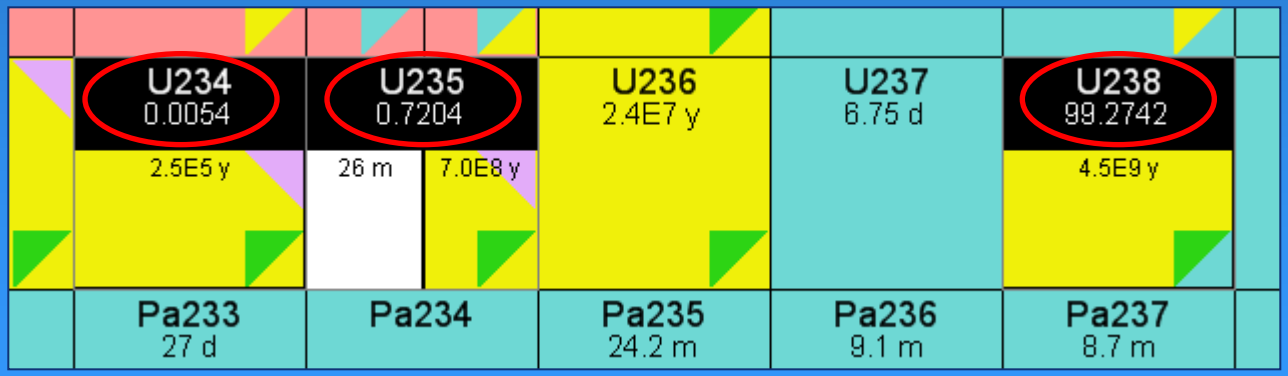
Case Study:

Natural Uranium

Create a nuclide mixture for 100 g uranium

Hint 1: Create a nuclide mixture for 100 atoms of uranium using the isotopic abundancies of natural uranium from Nuclide Datasheets or from Nuclide explorer

Hint 2: Use rescale feature to transform from 100 atoms to 100 g



Case Study:

Natural Uranium

My Mixtures | Edit | Upload | Sample Mixtures

Name

My natural Uranium

Description:

My natural Uranium:
99.2742 atom% U238
0.7204 atom% U235
0.0054 atom% U234

Nuclide	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
(add a new Nuclide)						
Total: 0	0	0	0	0	0	

Significant figures

Element: U | Mass: 238 | Quantity: 99.2742 | Unit: Number of Atoms | Update

Save Mixture | Reset | Cancel

Nuclide Datashe

92 Uranium

Current Chart: Karlsruhe

Element: U | Mass: 238

Reference Data | Description | Derived Data | Cross S

» Reference Data Notes

Density	19.1 g/cm^3
Mass Excess	47308.948 (± 1904) keV
Atomic Mass	238.050788247 (± 2044) u
Half-life	4.468 (± 3) Gy
Spin	0 ħ
Parity	+
Binding Energy	7.57012 MeV/nucleon
Abundance	99.2742 (± 10) atom %

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Case study: Add Uranium components

My Mixtures | Edit | Upload | Sample Mixtures

Name

My natural Uranium

Description:

My natural Uranium:
99.2742 atom% U238
0.7204 atom% U235
0.0054 atom% U234

Nuclide	Activity(Bq)	Mass(g)	Mass ratio	Mole ratio	Activity ratio	Delete
(add a new Nuclide)						
92 U 235	2.24826e-17	2.81172e-22	7.11404e-3	7.20439e-3	0.0440393	
92 U 238	4.88029e-16	3.92424e-20	0.992886	0.992796	0.955961	
Total: 2	5.10512e-16	3.95235e-20	1	1	1	

Element: U | Mass: 235 | Quantity: 0.7204 | Unit: Number of Atoms | Update

Save Mixture | Reset | Cancel

Nuclide Datas

92 Uranium

Current Chart: Karlsruhe

Element: U | Mass: 235

Reference Data | Description | Derived Data

» Reference Data Notes

Density	19.1 g/cm^3
Mass Excess	40920.456 (± 1823) keV
Atomic Mass	235.043929918 (± 1957) u
Half-life	703.8 (± 5) My
Spin	7/2 ħ
Parity	-
Binding Energy	7.59091 MeV/nucleon
Abundance	0.7204 (± 6) atom %

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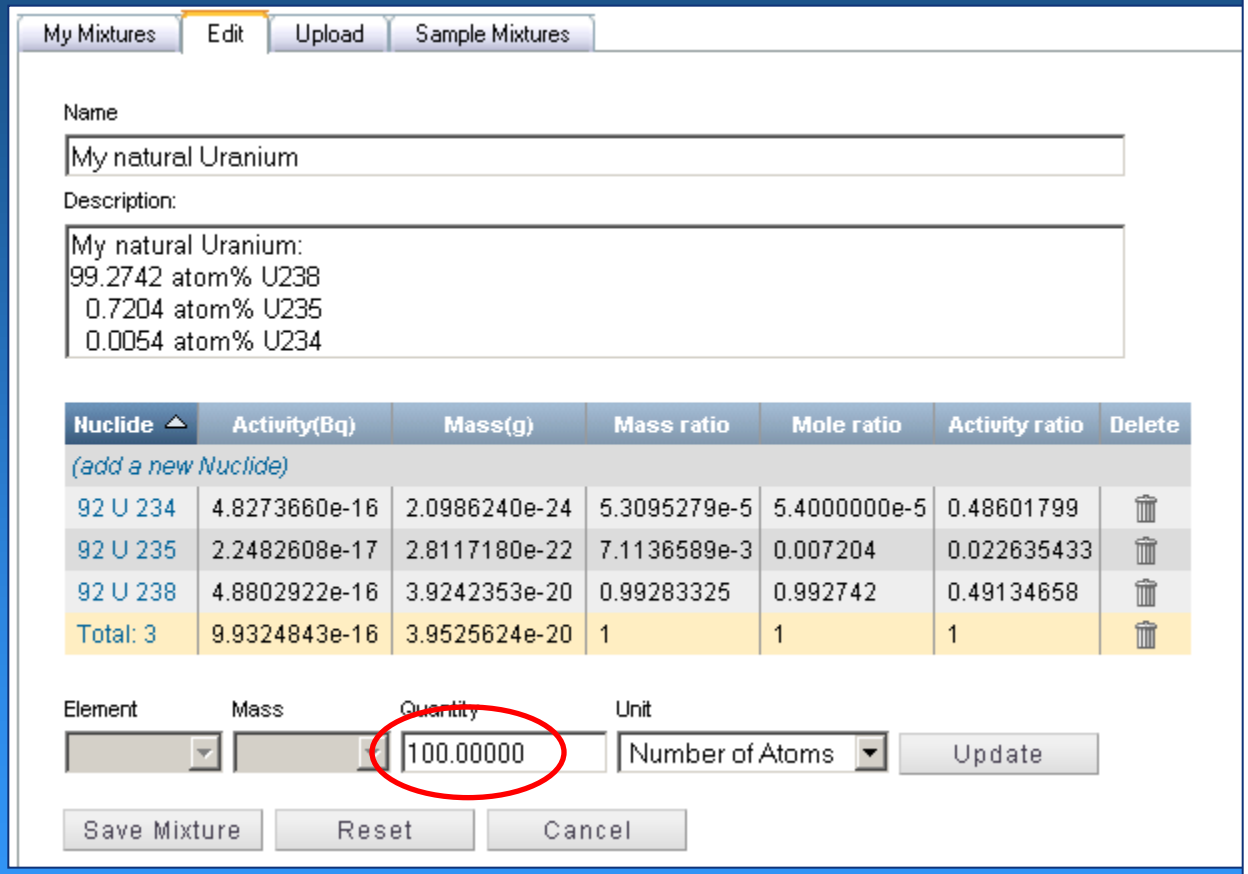
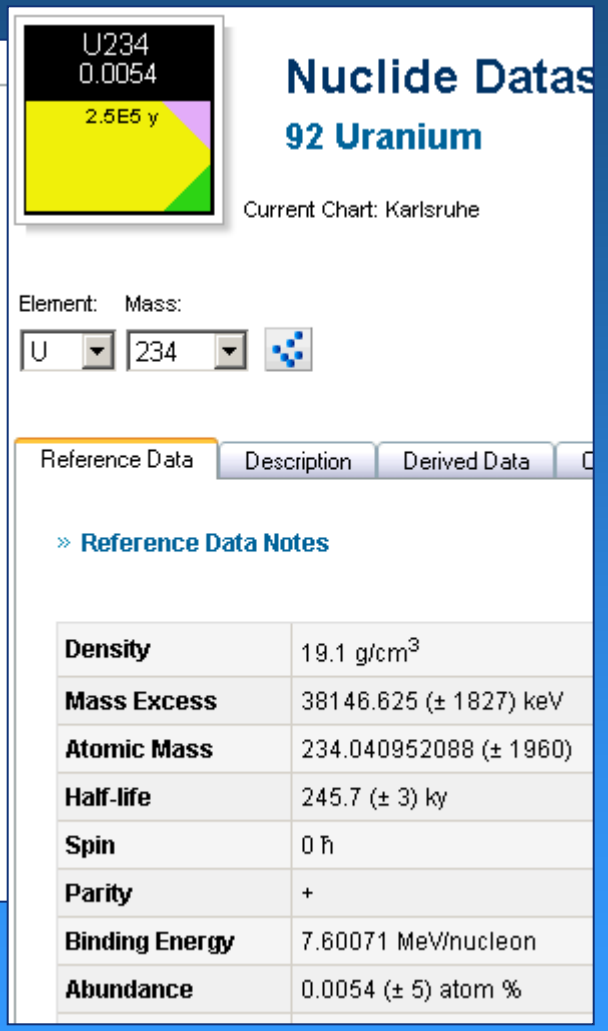
Case Study: Add Uranium components





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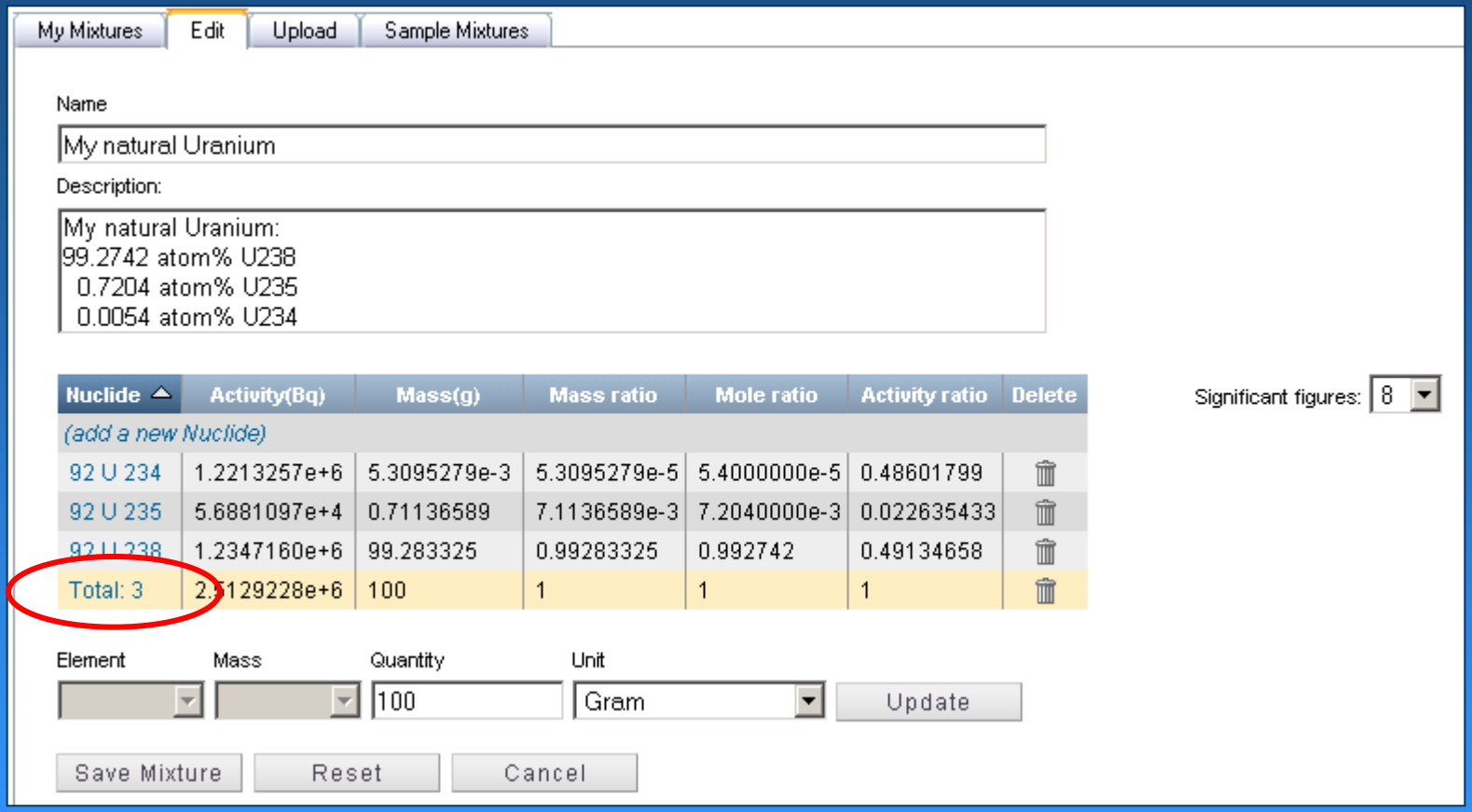
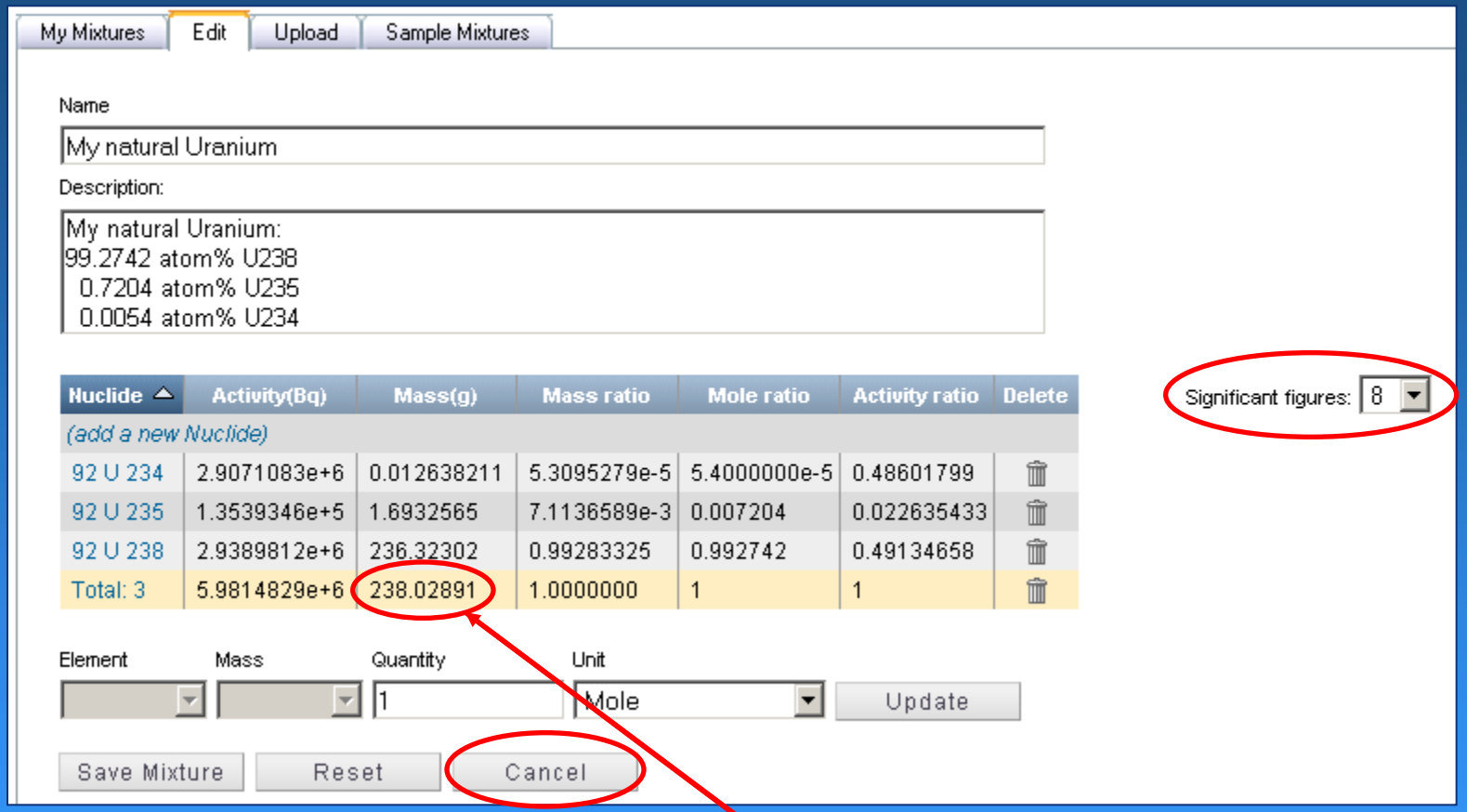
Rescale Feature:

„Total“ rescaled to 100 g



Case study: Atomic weight of U



Comparing with Karlsruhe Nuclide Chart: 238.02891

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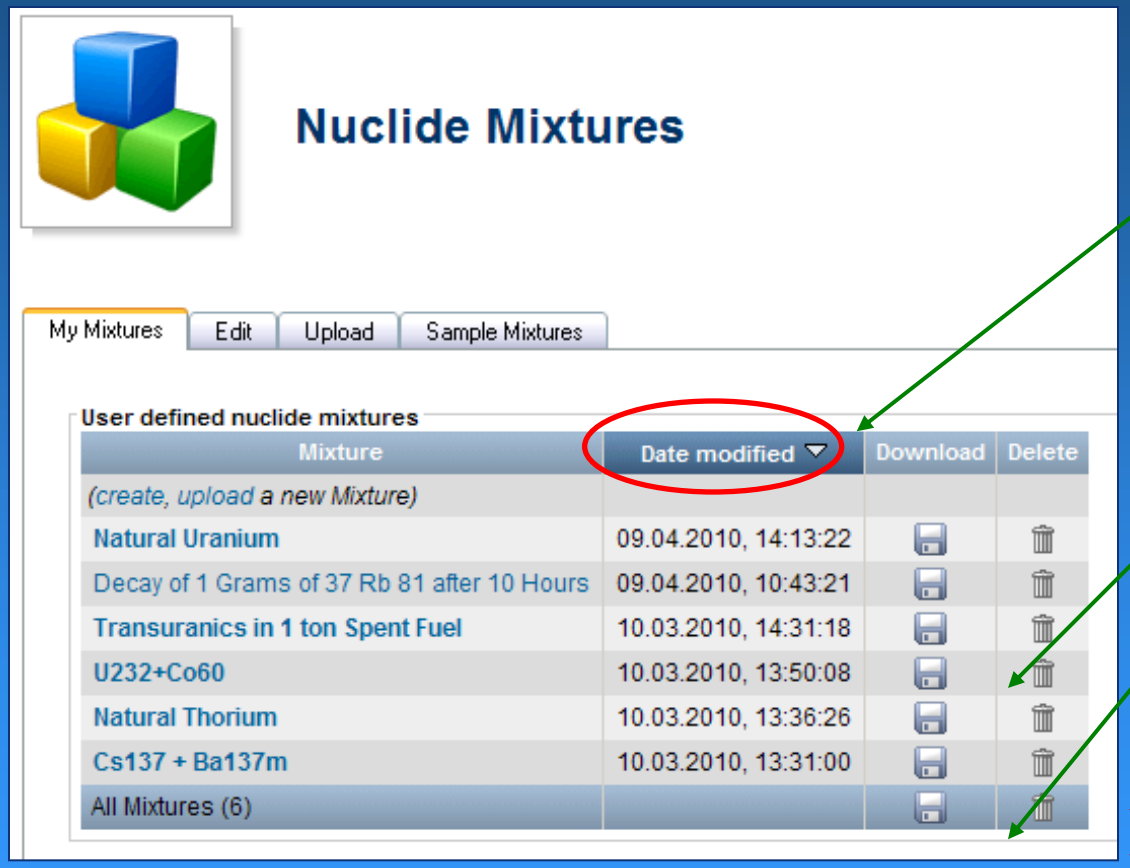
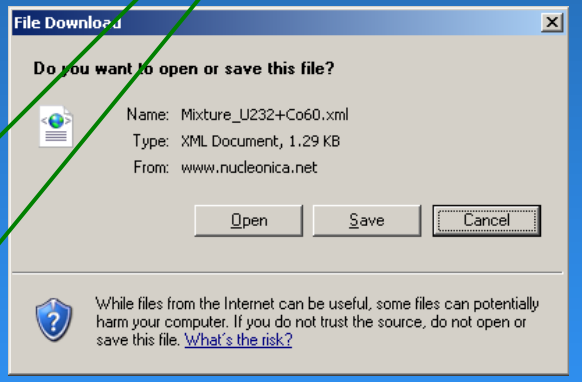
Nuclide Mixtures: Overview



Sorted by Date, descending order

Download (as XML file)

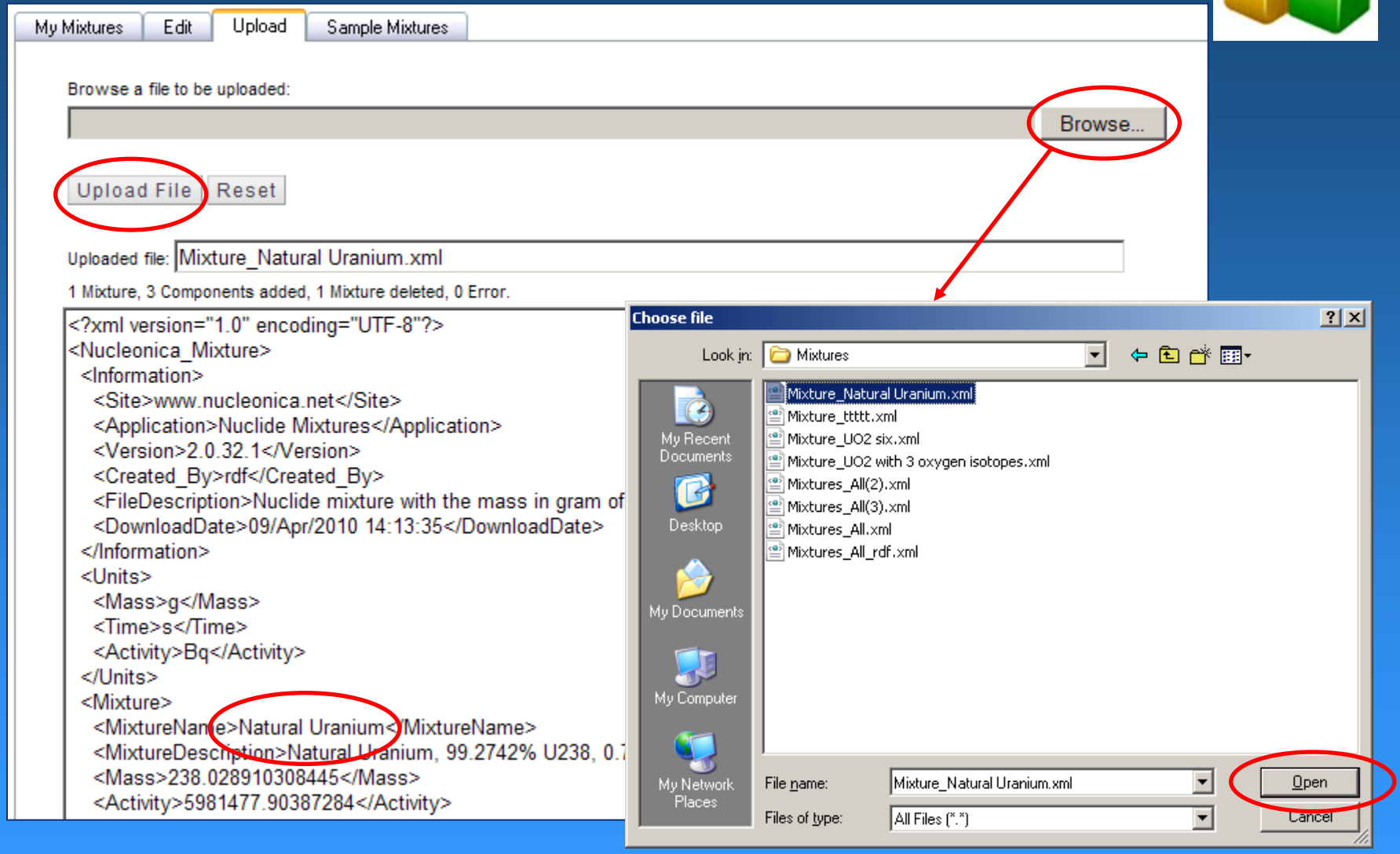
- This mixture
- All mixtures



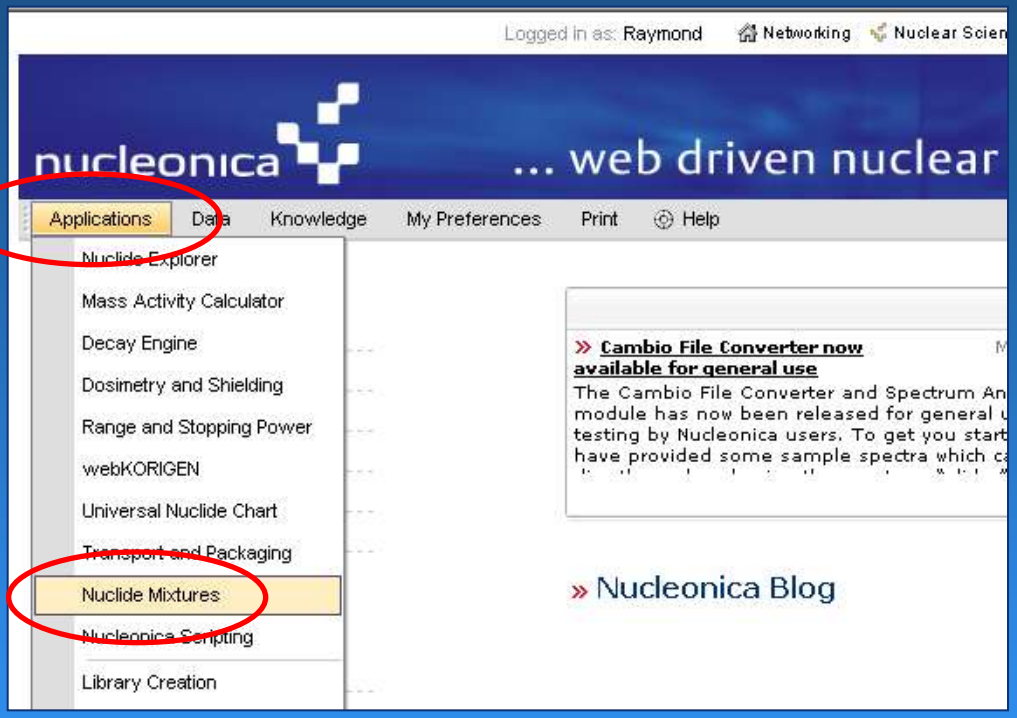
Delete

- This mixture
- All mixtures

Upload Nuclide Mixtures



Go to Nuclide Mixtures



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92 U 235	2.815e-15	3.521e-20	90.20	0.9880	0.9880	0.03912	
92 U 234	6.883e-14	2.992e-22	0.7700	8.398e-3	8.434e-3	0.9566	
Total: 3	7.196e-14	3.563e-20	91.30	1	1	1	

Significant figures: 4

Element: U | Mass: 238 | Quantity: 8.7 | Unit: Number of Atoms | Update

- Gram
- Becquerel
- Curie
- Number of Atoms
- Mole

Save Mixture | Reset | Cance

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Create a new mixture:

Save & Download mixture